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(21)Application number :   2000-350975 (71)Applicant :   MATSUSHITA ELECTRIC

IND CO LTD

(22)Date of filing :   17.11.2000 (72)Inventor :   WATANABE YOSHINORI

KOBAYASHI HIROKAZU

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(54) RADIO EQUIPMENT AND RADIO NETWORK

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce interference in a radio LAN and to increase the number of radio LANs to be contained in the fixed number of radio channels.

SOLUTION: An optimal channel is decided by judging radio wave states of all the usable radio channels, in the case of startup and the optimal channel also for changes of surrounding state is decided by periodically stopping the transmission of the present station by a master station and distributively monitoring neighboring radio wave state by a slave station in present radio network. Furthermore, in the case of shortage of channels, storage of more radio networks is enabled with fewer radio channels by sharing and using the channel being used by other network by mutually mediating it.

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CLAIMS

[Claim(s)]

[Claim 1] It is the wireless network which consists of a child office which performs data communication, and a key station which performs control of each child office. A key station Measure the receiving reinforcement of an usable radio channel, and when said receiving reinforcement is below constant value, it is vacant and this is judged to be a channel. The wireless network characterized by adding into a beacon the information on said empty channel chosen by making an empty channel selection which chooses either as a use channel among empty channels as information, and transmitting to a child office.

[Claim 2] It is the wireless network which a key station transmits the monitor beacon which forbids transmission of a fixed time amount child office among transmitter meetings, a child office suspends the period packet transmission directed when said monitor beacon was received, measures received field strength in the meantime, and notifies said receiving reinforcement to a key station.

[Claim 3] Claims 1 and 2 for which access of a wireless medium uses the centralized-control communicate mode with which a child office communicates by

mediation of a key station are the wireless networks of a publication either. As opposed to other key stations detected based on the bit error rate and channel load factor which asked for the key station judged as there being no unassigned channel in said key station A use demand command is published so that the same channel as a key station besides the above can be used. Change to a slave key station, a key station besides the above changes to a master key station, and the parameter of a centralized-control communicate mode time is exchanged mutually in said slave key station and said master key station. The wireless network characterized by computing a new centralized-control communicate mode time so that duration of service may not lap.

[Claim 4] The wireless section which is the radio equipment which has the function of the key station which controls a child office, and performs the frequency selection and conversion of a signal which were received with the antenna, The recovery section which restores to the output of said wireless section to baseband signaling, and the MAC section which discriminates a bucket from the signal to which it restored, The error rate test section which measures an error rate from the signal to which it restored, and the received field strength test section which measures the receiving reinforcement of a channel with the signal from said wireless section, When it is vacant from said received field strength, a channel is judged to be the channel-load test section which measures a channel load from the output of the MAC section and it is judged with said unassigned channel not being found Radio equipment which has the control section which publishes a use demand command to other key stations detected based on said error rate and said channel load factor so that the same channel as a key station besides the above can be used.

[Claim 5] A slave key station is a wireless network according to claim 3 characterized by transmitting the beacon frame of said slave key station which has a

centralized-control communicate mode time parameter value when receiving the beacon frame from a master key station, and transmitting the quit command of the centralized-control communicate mode if centralized-control communication link modal parameter time amount is completed.

[Claim 6] A master key station and a slave key station are a wireless network according to claim 3 characterized by relaying this packet to a destination child office via a partner key station and a key station when the destinations are a partner key station and a child office under that management in the communication link from a local station and the child office under local station management.

[Claim 7] Claims 1, 2, 3, 5, and 6 are the wireless networks characterized by starting this as a use radio channel when it has a means by which a key station memorizes a use radio channel in the wireless network of a publication and a former use channel exists in a power up in this storage means either.

[Claim 8] It is the wireless network characterized by controlling so that a key station shifts to the centralized-control communicate mode from the distributed management communicate mode to the terminal in which the centralized-control communicate mode is possible, when it sets to the wireless network which claims 1, 2, 3, 5, and 6 are the wireless networks of a publication either, and uses the distributed management communicate mode by carrier sense access and the frequency of the collision at the time of transmission of each station becomes high.

[Claim 9] Claims 3, 5, and 6 are the radio equipment used for the wireless network of a publication either. A master, and the key station of a slave and the child office under each management have the same network identification child and a user identifier corresponding to a key station. It is the radio equipment which measures encryption in a user identifier and has the function in which a key station accumulates traffic information based on a user identifier when using a network identification child for

authentication between a key station and a child office and realizing unknown episode nature further.

[Claim 10] It is the radio equipment which has the function in which claims 3, 5, and 6 are the radio equipment used for the wireless network of a publication either, a master **** slave key station and the child office under each management are the cases where it attests by this network identification child that has a network identification child in each, and a key station accumulates traffic information based on a network identification child.

[Claim 11] It is the gateway unit for wireless networks which is a gateway unit which has a connect function with a public network in claim 9 and a wireless network given in ten, and accumulates the communication link traffic information on a line wire for every network identification child when a user identifier is used and a user identifier is not used for every user identifier.

[Claim 12] The wireless network characterized by controlling so that this child office relays the communication link between these key stations when both key stations and a communication link are possible for the child office which are claims 3 and 5 and a wireless network given in six, and exists between the key stations which cannot communicate mutually [claim 13] It is wireless network equipment [claim 14] characterized by for a key station having the reception function of a global positioning system in claim 1 and a wireless network given in two, and acquiring network synchronization information from the receipt information from this positioning system. The wireless network characterized by preparing the repeater which broadcasts the signal of a global positioning system again indoors from the outdoors in the wireless network which was with wireless network equipment according to claim 13.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a wireless network and the wireless network for self-management used especially in a home, a school, office, etc.

[0002]

[Description of the Prior Art] There is IEEE802.11 wireless LAN as a representative of an independent wireless network. The frequency band for wireless LAN is divided into two or more channels at the appearance shown in specification, and wireless LAN operates using one of the multiple channel. For example, in the case of the 5.15GHz - 5.25GHz 100MHz band, it is divided into four of the channels 1-4 shown in drawing 13 , and using it, choosing one of channels of this is prescribed by Japan. The access approach of IEEE802.11 wireless LAN is explained using drawing 2 and drawing 3 .

[0003] In drawing 2 , the key station called the access point (it abbreviates to AP henceforth) which takes the lead in wireless LAN exists, and 1 consists of two or more stations (ST1-ST5) of 2-6 which are a child office. The circle in drawing shows the attainment range of the electric wave from AP.

[0004] In drawing 3 , AP1 transmits the special packet 7 called a beacon frame the fixed period expressed a beacon period (TBCN). A beacon has reporting existence of AP to all the area of wireless LAN, and a function used as the origin of a PCF communication link. At IEEE802.11 wireless LAN, it is the centralized-control communicate mode (PCF mode is called henceforth.). PCF:Point Coordination Function and the distributed management communicate mode (DCF mode is called henceforth.) The two communicate modes of DCF:Distributed coordination Function exist.

[0005] PCF mode is the mode in which mediation of the access privilege of a radio-transmission medium is performed intensively, and AP realizes a mediation function. In a beacon, AP1 sets up the parameter called NAV (Network Allocation Vector), and, specifically, transmits.

[0006] This value shows the period when PCF continues following a beacon in the wireless LAN which AP1 manages, in the range which can be parameter set up, sets up maximum and usually transmits it (setting up an actually more long period).

[0007] If a receiving station receives the value of NAV of a beacon frame, this period will judge that it is a busy (condition currently used for other STs), and a radio-transmission medium will stop the transmitting function (DCF) by the carrier sense mentioned later. By this, each stations 2-6 will be in the condition that transmission is impossible, when there are no directions of AP, 1 and others. AP1 makes this transmit in this PCF mode, when polling 8 (it is the same number at drawing 2 and 3) is applied to ST1 of drawing 2 and ST1 has the transmitting packet 9. At the time of the polling to ST2, this packet 11 will be added to the polling packet 10, and AP1 will transmit, if the packet addressed to ST2 from ST1 is received.

[0008] Thus, at PCF, the communication link between STs is realized under the mediation of AP instead of mediation between each ST. AP1 sends out the command packet (PCFend) 12 of PCF period termination, and this PCF period ends it because each stations 1-STs 5 receive this.

[0009] Although this example showed the communication link by polling, it is able for each ST to be able to access a radio-transmission medium and to realize a PCF communication link without mediation between STs by this also by TDMA. Since the access privilege to a medium turns around a PCF communication link to a beacon period at each station and the arrival time delay of a packet can restrict within constant value, it is suitable for isochronism data communication, such as voice and

an animation.

[0010] Each ST will be the method which transmits uniquely (an access privilege is arbitrated dispersedly), and DCF will be a method typically called CSMA/CA (carrier Sense Multiple Access with collision avoidance), if each ST judges that the carrier of a radio-transmission medium (channel) is detected independently, and the transmission medium is not used.

[0011] In the beacon period (TBCN), it is guessed except the PCF period at the DCF period. In DCF mode, each ST can be transmitted without waiting for the polling from AP1, and the packets 13 and 14 in drawing 2 and 3 are the DCF communication links between ST3 and ST4. Packet arrival to this mode destination can be realized early. Moreover, it is a method suitable for holding the burst traffic which data do not generate a fixed period.

[0012] Furthermore, although a gateway function is required in order that wireless LAN may connect with the external public network and service of the Internet etc., the same equipment as AP usually shown in one in drawing 2 realizes.

[0013]

[Problem(s) to be Solved by the Invention] Although wireless LAN operated using one of two or more radio channels, the selection approach of a channel was not specified clearly.

[0014] For this reason, since a limitation was in the usable number of radio channels when wireless LAN spreads widely as a domestic wireless network, the same channel might be chosen disorderly, without the wireless LAN of an adjoining home arbitrating mutually, and the station of wireless LAN had the technical problem which communication failure generates frequently by interference in this case. Since comparatively long contents, such as a movie, were transmitted a fixed period when especially PCF mode operates, there was un-arranging [that interference generated

PCF by operating to asynchronous in contiguity wireless LAN, and a PCF communication link could not be performed].

[0015] Furthermore, since the operating frequency channel of each wireless LAN was not arranged the optimal when it crosses to a wide area and two or more wireless LAN exists, the technical problem that the number of wireless LAN which can be held in a certain number of fixed channels decreased occurred.

[0016] This invention aims at reducing interference in wireless LAN, and increasing the number of hold wireless LAN in the number of fixed radio channels.

[0017]

[Means for Solving the Problem] AP which controls each station in the wireless LAN of this invention carries out fixed time supervision of the operating condition of all radio channels, the optimal empty channel for use is chosen, the communication environment of all usable radio channels is supervised still more nearly periodically, if , it is the wireless network controlled to reselect a radio channel, and the duplication probability of the use channel between adjoining homes can be reduced.

[0018] Furthermore, when AP is vacant at the time of starting and a radio channel does not exist, a load is the lightest among radio channels and it is possible to suit in the wireless network controlled to operate as a slave AP under the influence of this AP, to arbitrate a PCF period mutually as wireless LAN, and to operate to other good AP of a received electric-wave situation, and to increase the number of hold wireless LAN in the number of fixed radio channels.

[0019]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained.

[0020] The configuration of the key station (AP) of the wireless LAN by this invention is shown in drawing 1 . 86 in drawing is an antenna and 71 is the wireless section,

and in the wireless section 72, channel (frequency) selection and conversion in IF frequency are performed about the signal received with the antenna, and it is changed into baseband signaling in the strange recovery section 73, and is inputted into the MAC section 73. In the MAC section, it has discernment and the reception function of a packet, and received data are stored in memory 74 via an internal bus 76.

[0021] The transmit data which transmission operated in the reverse procedure and was stored in the memory section 74 is packet-ized in the MAC section 73, and if a transmission line is judged to be ready-for-sending ability, it will be transmitted to a transmission medium (space) via the strange recovery section 72, the wireless section 71, and an antenna 86.

[0022] A control section 75 performs data transfer with the exterior via an external interface 77 while starting control of each part in ST, and transmission and reception of a packet.

[0023] Having the function which measures the packet traffic volume (rate of a channel load) in the channel as which 85 was chosen in the bit error rate in the channel as which 84 is chosen for 83 in the wireless section in field strength, a control section 75 acquires empty channel judging information from these measurement results.

[0024] When the receiving reinforcement of the measured radio channel is below constant value, a control section 75 is vacant, judges this to be a channel, and chooses either as a use channel among empty channels.

[0025] When there is no unassigned channel, the signal quality of a channel is good (a bit error rate is ** low), and other key stations where the packet traffic volume (rate of a channel load) in a channel is light are looked for, and the same channel as this key station is used.

[0026] Drawing 4 is the example of 1 configuration of the wireless network (wireless LAN is called henceforth) where this invention is applied. It is crowded with houses and the case where each home holds self wireless LAN for every house is assumed. The key station (access point: AP 15-22) which realizes the child office (station: ST) of the wireless LAN which performs data communication and communication link between STs, communication facility with the outside of **, etc. exists in each home.

[0027] Now, I think that the usable channel of wireless LAN is four channels (CH0, CH1, CH2, CH3, and CH4) of drawing 13 . Since being distinguished by different color with, without being the same as that of the color coating problem on the map in mathematics, and using the same color four colors in that ********** area is proved, covering a fixed area by two or more radio channels should just have four channels. However, like a public cellular phone, this is the case where strict frequency management is performed, and optimum frequency arrangement is difficult for it in the wireless LAN whose self-management is a premise.

[0028] Now, since AP16-AP21 of a surrounding home are using radio channels CH1, CH2, and CH3, AP15 installed in the home of the slash section in drawing 4 must choose CH4 essentially. Otherwise, the same frequency will be used at neighboring houses and the case where it becomes impossible for interference to receive data especially in a PCF communication link generates ST of a location which can receive the same channel electric wave from both a house and a neighboring house.

[0029] According to invention of the 1st of this application, AP15 can choose CH4 autonomously here. This selection approach is explained using the flow chart of drawing 5 .

[0030] As shown in drawing 5 , from powering on or reset, fixed timing measurement of the field strength and the packet load which communicates of a radio channel is carried out, and these are memorized. When field strength is below a regular value, it

is vacant and this is judged to be a channel, and a channel number is memorized together with the value of received field strength.

[0031] If AP already exists in a certain channel, since a beacon will be received a specific period, it is detected easily that the channel is not vacant.

[0032] All radio channels are searched, and when the number of empty channels is one, let this be a use radio channel. When there are two or more access channels, one is chosen by a certain criteria (for example, it is that the small thing of the numeric value of an empty channel number, a large thing, or a random number determines etc.). In the case of drawing 4 , AP15 detects that CH 1-3 is used by the actuation based on the flow of drawing 5 , and chooses CH4 autonomously. Although an empty channel may not be found, about the processing in that case, it mentions later.

[0033] When an empty channel is found, AP changes to the beacon frame sending-out processing shown in drawing 5 . Since a beacon is sent out periodically, the beacon timer which minces a period is initialized, information required for a beacon frame is stored, and a beacon is sent out. In the case of the method which judges a packet transmitter meeting by carrier sense like IEEE802.11, before transmission, there is no carrier and a thing check is carried out. Furthermore, in this invention, there is a parameter called a monitor interval counter and the special beacon called a monitor start beacon is transmitted once to several times of the usual beacon transmission. In order that the period which a NAV parameter (Network allocation vector: Reception ST judges only this parameter time amount to be under use of a transmission medium, and does not perform packet transmission) shows to each ST may go into PCF mode, ST under self-AP management does not transmit to this beacon. In this period, all carry out radio-channel Seki, and they are received field strength and a packet error rate. The instruction which supervises a communication link load is included.

[0034] By this, each ST will supervise all the channel receiving environments of the perimeter of self-ST after monitor start beacon reception.

[0035] The initial procedure by the side of ST is explained using the flow chart of drawing 6 . The bottom is the usual initialization actuation, and powering-on **** can receive a beacon frame to all channels after reset, and it inspects whether a network identification child is the same. A network identification child is an identifier which shows whether it should operate as single wireless LAN under the same manager, and a wireless LAN device with the same identifier constitutes the same wireless LAN system here.

[0036] When a beacon with the same wireless network identification child (it is called an ESS identifier by IEEE802.11 specification) is received, while it is decided that the received radio channel will be a future use channel, parameters, such as transmitted power which exists in a beacon and which was specified beforehand, are received, and the operating condition of a local station is set up. Even if it inspects all channels, when a beacon is not received, it judges that AP does not exist and a user is notified of that. (Or if the mode (ad hoc mode) in which it operates without AP can operate, changing there is also possible, but since there is no direct relation, it is not described as this application here) .

[0037] Furthermore, the drawing 6 bottom explains actuation of each ST to the monitor beacon mode stated by drawing 5 . It judges whether whenever ST in normal operation also receives a beacon, it is a monitor beacon and has the same identifier as a self-network identification child. when it is the monitor beacon which fulfills conditions, only the period which the NAV parameter in the beacon shows like the usual PCF mode suspends transmission until it receives the quit command of the PCF period from AP or.

[0038] Since all STs of AP participation that sent out the monitor beacon have

suspended transmission in the meantime, the electric waves received are not self-wireless LAN but other electric waves from AP and ST. About all radio channels, the data of received field strength or a packet load profile initiation are taken and stored, and it notifies to AP. drawing -- each time -- AP -- notifying -- as -- indicating -- having -- **** -- although -- several times of monitor beacons -- 1 time -- ****** -- transmit timing -- arbitration -- even when -- it is possible.

[0039] Moreover, since packet load information etc. needs remarkable prolonged observation, you may supervise over several times of monitor beacons. Here, the reason all STs supervise the interference electric wave from Contiguity AP will be because there is also a thing without that right and the relation cannot be held in advance to AP in many cases, if there are some which are arranged in the place near AP of the neighboring house which is a source of interference depending on ST.

[0040] AP to which the monitor result was notified from ST to the monitor beacon should change a use radio channel from the situation of interference -- ** -- if judged, a new radio channel will be chosen according to a flow [given in drawing 5] of operation.

[0041] The condition of a monitor beacon is explained using drawing 6 . In wireless LAN, AP ((1) in drawing) transmits the monitor beacon 24 for the beacon frame 23 a period longer than it periodically. ST ((2) in drawing) which received the monitor beacon carries out a fixed period of the transmission (25 in drawing). Although ST starts the monitor of an electric-wave situation at this period, if it is shown in 26 and also there is interference (inside of drawing (3) and (4)) from AP and ST of wireless LAN, this received field strength etc. will be recorded and it will notify to AP. Supervising targets not only the same radio channel but all radio channels.

[0042] By this invention given in claims 1 and 2, reexamination by all STs is performed with a fixed period, and the selection of the very optimal radio channel also

of the radio channel judged to be the optimal by only AP is attained at the power up of AP.

[0043] Next, drawing 8 and 9 explain the case where it is vacant at the time of starting of AP equivalent to this application claim 3, and a channel does not exist.

[0044] The configuration of the key station (AP) of the wireless LAN by this invention is shown in drawing 1 . 86 in drawing is an antenna, 71 is the wireless section, and the received signal is changed into baseband signaling in the strange recovery section 72, and is inputted into the MAC section 73.

[0045] In the MAC section 73, it has discernment and the reception function of a packet, and received data are stored in memory 74 via an internal bus 76. The transmit data which transmission operated in the reverse procedure and was stored in the memory section 71 is packet-ized in the MAC section 73, and if a transmission line is judged to be ready-for-sending ability, it will be transmitted to a transmission medium (space) via the strange recovery section 72, the wireless section 71, and an antenna 86.

[0046] A control section 75 performs data transfer with the exterior via an external interface 77 while starting control of each part in ST, and transmission and reception of a packet. The above is the same function as ST.

[0047] 78 in drawing is the beacon generation section, and transmits a beacon periodically as AP by expiration of the BIKON period timer (TBCN timer) 79. Moreover, although AP manages a centralized-control communicate mode (PCF) period, the TPCF timer 80 operates after beacon transmission, and if a PCF period expires, the PCFend command will be transmitted via the PCFend generation section 82. Thereby, PCF period termination is reported to all STs under AP management.

[0048] At the time of a master / slave AP mode, it is exchanged in the information on the PCF period which each wireless LAN needs between Master AP and Slave AP,

and a new PCF period is computed. Each AP has this value, sets a value as the TPCF timer of 80 in drawing, and manages a new PCF period. Each AP controls PCF periods, such as polling, to the appearance (for example, Master AP uses a PCF period previously) with which a PCF period does not lap.

[0049] 82 in drawing is the clinch section of the beacon/PCFend by this invention, and only when AP is set as Slave AP, it is activated. When a PCF period initiation beacon is received from Master AP, the beacon in which a slave key station also has the PCF period of the equivalent immediately by this part is transmitted. When PCFend arrives, the multiple address is similarly carried out also from Slave AP. Since a PCF period is reported to all STs of the receiving range of a master AP electric wave, and all STs of the receiving range of a slave AP electric wave by this, ST which transmits a packet to a PCF period accidentally stops existing, and interference of mutual wireless LAN is lost by it.

[0050] Moreover, since a PCF period can be terminated by the beacon and PCFend transmitting function of 78-81 which are held uniquely also when the beacon from a master and PCFend do not reach a beacon / PCFend clinch section normally by the transmission error, a transmission medium is not occupied accidentally and safety is raised.

[0051] In addition, the function of 78-82 is realizable with not only hardware but software.

[0052] The drawing 8 upper case is the case where wireless LAN is introduced into the private house which crowded like drawing 4 , and presupposes that assignment of a frequency has already ended the optimal using the electric wave of CH1-CH4 in the part shown by six square shapes. The case where the need of newly putting an access point on the part shown with the circle of the slash of drawing by this condition occurs is considered.

[0053] In this case, although AP27 operates according to the initialization procedure of AP shown in drawing 5 , in order that it may become clear that there is no channel which supervised the operating condition of all channels and is vacant, what (it hangs down) is participated in the channel which the existing wireless LAN is using is tried. In the lower berth of drawing 8 , AP27 will operate as a slave AP of other AP28 (Master AP is called), and will use the same radio channel (CH4) as Master AP.

[0054] Here, if the same radio channel is used only without mediation as the term of a technical problem explained, interference will occur, and in PCF mode, a communication link becomes impossible. for this reason, when using the same radio channel, it hangs down and the condition of wireless LAN of having cooperated after arbitrating by mediation (habitat segregation) on the time-axis in PCF mode being required is called the mode (the wireless LAN which newly participates in the wireless LAN in which this already exists -- " -- it hangs down -- " -- this name is used from things).

[0055] Actuation of AP is shown in the flow chart of drawing 9 .

[0056] If it judges with the flag according [whether it hangs down first and mode transition is carried out and] to a user setup and the transition to the mode is forbidden, AP will notify a user of there being no empty channel, and will end actuation.

[0057] If hanging mode is permitted, the hanging demand packet in which a network load contains the self-address and a network identification child to AP lighter than constant value above the fixed value to which received field strength was set beforehand will be transmitted to AP of this channel among the receive states of each channel judged by the search of an empty channel. When an authorization response packet is received from Destination AP, AP changes to Slave AP.

[0058] When a refusal response is received, a hanging demand is published one by

one to other AP corresponding to conditions. When refused by all, AP notifies a user of this and suspends actuation.

[0059] It is necessary to perform adjustment and management (habitat segregation) of a transmission-medium time with PCF mode with Slave AP here to AP for which the same wireless LAN channel is already used (master).

[0060] Habitat segregation actuation of PCF is explained using the bottom and drawing 10 of drawing 9 . Slave AP and Master AP which performed the affirmation communication link to "a hanging demand" in drawing 8 exchange parameters, such as a beacon period (TBCN) which is needed by self-wireless LAN for habitat segregation PCF mode, and a PCF period (TPCF), and calculate a beacon period with new Master AP (possible, whichever AP takes charge strictly), and a PCF period. Usually, a new PCF period serves as the sum of the PCF period which both AP demands. After parameter exchange, although AP quotas and serves as a master of PCF, and a slave mode, drawing 10 explains the actuation at this time.

[0061] 29 of drawing 10 (1) -- Master AP and 30 -- Slave AP -- it is -- ST1 affiliated with AP29 in 31 and 32 -- there are ST2. 33 and 34 are ST3 and ST4 affiliated with AP30.

[0062] If the demand PCF period of wireless LAN when TPCF29 and AP30 manage the demand PCF period of the wireless LAN which AP29 manages with the procedure shown in drawing 9 is set to TPCF30, the relation between a new PCF period (new TPCF) and a beacon period (TBCN) parameter will turn into relation shown in drawing 10 (2). Shortly after transmitting a master AP 29 and the beacon frame BCN29 which set up NAV appropriately, AP30 gives the timing which transmits a beacon.

[0063] AP30 transmits the beacon frame BCN30 with the same NAV immediately. After this, AP29 polls ST affiliated with self-wireless LAN at the period of TPCF29 immediately, and the period of TPCF30 does not communicate but it transfers a right

to AP30 (a drawing medium wave line shows). Similarly, the period of TPCF29 does not communicate but AP30 performs the communication link by polling of ST subsidiary in the period of TPCF30.

[0064] If new TPCF time amount is completed, the PCF period quit command PCFend29 will be transmitted, AP30 will transmit PCFend30 immediately similarly, and AP29 will end habitat segregation PCF mode. When AP29 transmits a beacon BCN29, since ST33 exists in the location which cannot receive the signal from AP29 under the influence of AP30, it cannot receive BCN29.

[0065] Although ST33 does not recognize that a PCF period starts at this time, it becomes possible [recognizing existence of a PCF period] by receiving the beacon BCN30 from AP30 immediately after. It is the same also about reception of a PCF quit command. Thereby, to both STs of all affiliated with AP, the notice of a habitat segregation PCF period is possible, and transmission by DCF mode occurs accidentally, or problems, like a PCF period laps are lost, and a stable communication link is attained. Here, although the beacon and PCF quit command of Master AP are ahead of it of Slave AP, the same effectiveness is acquired also when reverse.

[0066] Although explanation showed the case where two wireless LAN shared the same radio channel, the configuration in which two or more slaves AP exist to one master AP, and the configuration by which column connection of the three or more wireless LAN is made with subordination completion are also possible.

[0067] Moreover, although a PCF period may be immobilization, it is possible that the long connection of a connect time is added and deleted like video transmission. In this case, in case a connection is generated and deleted, the information on the TPCF period of each [between AP] is exchanged, and a transmission medium can be more efficiently used by carrying out whole TCF period readjustment. Since TV program etc. has the long connect time, there are so few overheads by TCF

readjustment that they can be disregarded.

[0068] In addition, although the method of arbitrating the PCF period of two or more wireless LAN (habitat segregation) is indicated in invention (JP,11-219737,A) by applicants for this patent To all STs on two or more wireless LAN which shares PCF mode from one set of AP, even when it cannot communicate (hiding terminal condition), by carrying out the multiple address of the PCF period which was arbitrated according to this application from all AP It is notified to all STs, it is stabilized [ST which misunderstands a PCF period does not occur,], and wireless LAN can be operated.

[0069] Furthermore, since according to invention of claim 4 AP29 and AP30 have the relation which can communicate mutually even when ST1 of 31 in drawing 10 communicates with ST3 of 33, it is possible for AP30 to receive the packet 35 which answered polling of AP29, and to relay a packet 36 to the polling opportunity of AP30 to ST3 of 33. The mutual communication link between STs is possible by also setting at DCF periods other than a PCF period, AP29 and AP30 receiving the packet of ST affiliated with Partner AP as a bridge, and relaying this, if it is ST affiliated with a local station.

[0070] As mentioned above, although it is the initialization procedure of the described wireless LAN By that possibility that a use channel will change each time is low especially that an electric-wave environment does not change frequently by home use, and the invention in this application that supervises an electric-wave environment periodically even if it changes By accumulating the information on the radio channel once set as appearance according to claim 5 in the non-volatile storage element of AP, and kicking in starting using this value at the time of power-source starting, since it can respond In addition, since [for which ST is controlled to follow in footsteps of the channel selection of AP automatically] initialization time amount is

shortened, it does not have storage for ST itself.

[0071] When it is the compound wireless LAN which drawing 9 and the wireless LAN which uses the same channel explained using 10 combined, and realizing this, two kinds can be considered by the view of authentication and management.

[0072] First, it is the case where a master, Slave AP, and all STs have the same network identification child (BSS-ID and equivalence in IEEE802.11) in appearance according to claim 7, and AP is considered to be the single wireless LAN existing [two or more]. Under the present circumstances, when original Master AP and original wireless LAN differ from the carrier of Slave AP and its wireless LAN, it is necessary to hold the confidentiality of a communication link of wireless LAN for every carrier.

[0073] For this reason, it is indispensable that introduce the new identifier which shows a user (carrier) given in this application, and this secures unknown episode nature, such as encryption. Moreover, since the same wireless medium is shared, it is necessary to manage the operating condition appropriately, and AP manages traffic for every user identifier.

[0074] Other approaches are the cases where it has a different network identification child for every wireless LAN of a master and a slave. Although two-way communication in this case is realized using the identifier (ESS-ID of IEEE802.11) of extended wireless LAN, since it is necessary to perform management of traffic for every user too, as shown in claim 8, in AP, traffic administration is performed for every network identification child. The network example for homes by claim 3 and the wireless network of four publications is shown in drawing 11 .

[0075] This is not the case where an empty channel does not exist. When wireless LAN 36 is introduced into a home 35, an electric wave may spread in the neighboring house 37. Usually, what an electric wave spreads at a neighboring house is an

example which uses this positively, although the device which prevents this is required since it becomes a source of interference to the wireless LAN introduced from now on. At a home 37, it is the case where the wireless LAN 36 of a home 35 hangs down positively, and service of the Internet etc. is enjoyed from AP39.

[0076] The gateway (GW) function with a line wire to connect is mounted in AP in many cases. AP39 shall be connected to the public Internet, such as CATV, DSL, and ISDN, among drawing. When shown in drawing 11 , management of unknown episode nature and traffic is performed by the approach indicated by claims 7 and 8. Furthermore, AP39 serves as GW function containing the database facility which accumulates the communication link traffic information on the line wire for every home in drawing.

[0077] The block diagram of GW equipment is shown in drawing 12 . Among drawing, 42 are the wireless LAN interface section and receive a packet from wireless LAN. A receive packet is transmitted to the junction judging section via an internal bus 47, it is judged whether it is the packet which should be relayed to the exterior, if it is a packet which should be relayed, it will be transmitted to a public network and the Internet interface 44, and it is connected and transmitted to public service of the Internet etc. 45 in drawing is the node processing section which controls the packet transfer in a node. Statistical information processing of the wireless LAN packet for every home by this invention is distinguished by a network identification child or the user identifier in this part, and is transmitted to the traffic database section 46.

[0078] Although drawing 6 and above-mentioned explanation have indicated so that AP40 may exist in a home 35, naturally direct ST41 grade is able to join AP39 of a home 35 directly. Also in this case, the line wire connection traffic of each home is managed by GW by this invention.

[0079] In drawing 11 , by the case where it is the gestalt to which AP40 and ST41 of a

home 37 hang down from the wireless LAN of a home 35, when receiving the wide area telecommunications service of charges, such as the Internet, by AP39 (it also has GW function in this example) course, it will communicate via AP39 of a home 35 altogether. The log function for every home is realized by the wireless LAN gateway function by this invention of claim 9, and it becomes possible to halve accounting of public service according to the traffic of each home etc.

[0080] In addition, although the example to which the wireless LAN terminal of a home 37 hangs down from the wireless LAN of a home 35 was shown, the wireless LAN terminal of other homes which adjoin further is able to hang down.

[0081] As mentioned above, it permits that the wireless LAN terminal of other homes 35 hangs down from the wireless LAN of a home 37, and when transfer of money which pays the countervalue to which a home 37 balances it to a home 35 occurs, if person-concerned through carries out directly, procedure is complicated, or an emotional problem may occur (delay, demand, etc. to pay). Service of a rental and maintenance of various wireless network devices including the service, AP and GW, and ST which install wireless LAN with the function of a publication in carrying out service which mediates this, and this application with the gestalt of loan from the beginning, invite the home of the neighborhood of an installation, and collect the fixed amount of a toll is also possible.

[0082] Said hanging mode suited the physical relationship with which between AP can communicate as shown in drawing 10 (1). However, this physical relationship is not always realized.

[0083] Even when the direct communication of between AP cannot be carried out, as for the existence case, ST53 which can communicate from both AP 51 and 52 as shown in drawing 14 (1) can realize hanging mode. In this case, ST53 is ST of AP51, and ST of AP52 is operated, and the communication link between AP51 and 52 is

mediated. This ST is called Proxy ST and let hanging mode by this ST be proxy hanging mode henceforth.

[0084] Each ST can judge that it is in the condition in which Proxy ST is possible by the monitor of the communication link condition of all channels with a monitor beacon by checking the packet reception from AP other than AP which is a key station.

[0085] AP specifies this ST as Proxy ST, when grasping whether ST exists in such physical relationship by monitor beacon response and carrying out proxy hanging mode (when there are more than one, a receiving situation chooses one ST for some reasons for a judgment of the better one etc.). The proxy ST 53 in drawing mediates AP51 and compound PCF mode in which it is said below that the packet between 52 is relayed to both AP. .

[0086] AP 51 and 52 can carry out actuation and the procedure of claims 3 and 4 also in the operating environment of drawing 14 (1), when Proxy ST exists. Furthermore, also in a slave AP 52, a beacon 52 and PCFend52 can be mostly transmitted to coincidence by relaying the beacon 51 in which initiation and termination of the PCF period from a master AP 51 are shown as shown in drawing 14 (2), and PCFend51 command as a proxy beacon and a proxy PCFend. Even when AP exists in the physical relationship of drawing 14 (1) by this, a collision and interference of the PCF period between AP can be avoided.

[0087] The case where a communication link is impossible through direct [between AP] and ST although hanging mode (when direct communication is possible between AP) and proxy hanging mode were explained (when it intervenes and the communication link between AP can do middle ST) is explained using drawing 15 (1). As for direct communication, the inside 54 and AP 55 of drawing cannot do, and STs 56 and 57 do not exist in the location of a proxy, either.

[0088] The circle of the continuous line of the radius L1 centering on the inside AP of

drawing is the attainment range of the electric wave in which data transmission and reception are possible, and L2 is range which gives a partner interference, although data transmission and reception are impossible. usually -- although it is L2>>L1 and is dependent on the frequency of the electric wave to be used -- L -- about 2 times of 2L1 -- taking .

[0089] In the case of this drawing, a channel which is different by technique according to claim 1 is assigned to AP, but the same channel is used when not recognizing empty channel existence. As for the inside 57 and STs 58 of drawing, when using the same channel, since interference is received from Partner AP, an electric-wave monitor with the monitor beacon of AP according to claim 2 will detect interference, and one of AP will abandon use of this channel. For this reason, the device which raises the utilization ratio of a channel further is needed.

[0090] When using the same channel by AP 54 and 55 of drawing 15 (1), in order to avoid interference by the continuation communication link of a fixed period like PCF mode, the habitat segregation on a time-axis is required for the appearance explained till the present. However, in independent wireless LAN, AP is not necessarily connected to synchronous networks, such as ISDN, like the public cellular communication link.

[0091] For this reason, since the synchronization between AP is realized, it is possible to take the synchronization between AP using positioning techniques, such as a global positioning system (GPS), as shown in drawing 15 (2). As for the inside AP 59 of drawing, the GPS antenna 61 receives the signal from the satellite 58 of GPS, and it receives exact time information. AP60 of another house receives a GPS signal by GPS repeater 62 course similarly. The GPS repeater 62 is equipment which broadcasts again indoors the GPS signal received outdoors, when a GPS antenna cannot be installed.

[0092] By this, AP 59 and 60 will hold exact time of day. Furthermore, it becomes possible by accessing network administration ST63, and coming to hand and exchanging the information on a beacon period and a PCF period through public networks, such as the Internet, to use it, dividing PCF mode, without colliding by two wireless LAN like the hanging mode of drawing 10 (2). When the direct communication of between AP cannot be carried out by this, and also when Proxy ST does not exist, the communication link of wireless LAN is possible without interference.

[0093] Drawing 15 (3) is the example of equipment of AP corresponding to GPS, it is the function as what is shown in drawing 12 that the antenna 64 of wireless LAN, the wireless LAN interface 65, the public network interface 66, and the node processor 67 are the same, and these are connected with the internal bus 68. the signal received from the GPS antenna 69 -- GPS reception -- un--- exact time of day is detected in 70, and it is sent to the node processing section 67. The node processing section controls the PCF period in wireless LAN in TEFEISU by this information and information on the beacon period and PCF period which comes to hand via a public network.

[0094]

[Effect of the Invention] According to this invention, in the wireless LAN installed in a home etc., selection of a suitable radio channel is possible.

[0095] Furthermore, since it makes it possible to operate as a part of other wireless LAN even when an empty radio channel does not exist, it is possible to increase hold wireless LAN also in the small number of radio channels.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] Drawing having shown the configuration of the radio equipment of this invention

[Drawing 2] The block diagram of wireless LAN with which this invention is adapted

[Drawing 3] Drawing showing the transmission signal on the wireless LAN for which this invention is adapted

[Drawing 4] The wireless LAN configuration Fig. with which explanation of this invention of operation is presented

[Drawing 5] The key station side flow chart with which explanation of this invention of operation is presented

[Drawing 6] The child office side flow chart with which explanation of this invention of operation is presented

[Drawing 7] The explanatory view of the supervision mode of this invention

[Drawing 8] The wireless LAN configuration Fig. with which explanation of the hanging mode of this invention of operation is presented

[Drawing 9] The key station flow chart with which explanation of the hanging mode of this invention of operation is presented

[Drawing 10] The explanatory view of operation with which explanation of the hanging mode of this invention of operation is presented

[Drawing 11] The block diagram of the home wireless LAN by which public connection is made when this invention is adapted

[Drawing 12] The block diagram of the wireless LAN gateway unit of this invention

[Drawing 13] The channel plot plan of wireless LAN

[Drawing 14] The explanatory view of operation with which explanation of the proxy

hanging mode of this invention is presented

[Drawing 15] The explanatory view of the network synchronization in the home wireless LAN which this invention became independent of of operation

[Description of Notations]

1, 15, 16, 17, 18, 19, 20, 21, 22, 27, 28, 29, 30, 39, 40 Key station (access point: AP)

2, 3, 4, 5, 6, 31, 32, 33, 34, 41 Child office (station: ST)

7 23 Beacon frame

8 Ten Polling packet

9, 10, 13, 14 Data packet

12 Centralized-Control Communicate Mode Quit Command (PCF Quit Command)

24 Monitor Beacon

25 Transmitting Prohibition Period

26 Interference Electric Wave

35 37 Home (house)

36 38 (home use) Wireless LAN

42 Wireless LAN Interface

43 Junction Judging Section

44 Public and Internet Interface

45 Node Control Section

46 Traffic Database

47 Internal Bus

51, 52, 54, 55, 59, 60 Key station (access point: AP)

53, 56, 57 Child office (station: ST)

58 GPS Satellite

61 GPS Antenna

62 GPS Repeater

63 Network Management Station

64 Wireless LAN Antenna

65 Wireless LAN Interface

66 Public Network and Internet Interface

67 Node Processing Section

68 Internal Bus

69 GPS Antenna

70 GPS Receive Section

71 Wireless Section

72 Strange Recovery Section

73 The MAC Section

74 Memory Section

75 Node Control Section

76 Internal Bus

77 External Interface

78 Beacon Generation Section

79 TBCN Timer Section

80 TPCF Timer Section

81 The PCFend Section

82 Beacon / PCFend Clinch Section

83 Received Field Strength Test Section

84 Error Rate Test Section

85 Channel-Load Test Section

86 Antenna